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The purpose of this final report is to document the ADST II effort, which supported the development of the Synthetic Environment Data Representation and Interchange Specification (SEDRIS) Application Programmer Interface (API). This report and the three other reports referenced include a full description of the experiment, its conditions, and lessons learned.

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Table of Contents

Introduction **1**
1.1 Purpose 1
1.2 Contract Overview 1
1.3 Experiment Overview 1
1.4 Technical Overview 1

2. Applicable Documents **2**
2.1 Government 2
2.2 Non-Government 2

3. System Description **3**
3.1 System Configuration 3
3.2 Internal Research and Development 3

4. Observations and Lessons Learned **4**
4.1 Project Scheduling 4
4.2 Data Complexity 4
4.3 Consumption Issues 4

5. Performance Evaluation **5**
5.1 Technical Performance 5
5.2 Financial Performance 6

6. Conclusion **7**

7. Points of Contact **8**

7. POINTS OF CONTACT **8**

Introduction

1.1 Purpose

The purpose of this final report is to document the ADST II effort, which supported the development of the Synthetic Environment Data Representation and Interchange Specification (SEDRIS) Application Programmer Interface (API). This report and the three other reports referenced include a full description of the experiment, its conditions, and lessons learned. A more detailed description of the software can be found in the Software Design Document (CDRL AB04). The methods used in validating the database interchange are documented in the Software Validation Document (CDRL AB05). The mapping of SEDRIS data object into and out of TARGET can be found in the Mapping Document (CDRL AB02).

1.2 Contract Overview

The TARGET SEDRIS effort was performed as DO #0043 under the Lockheed Martin Corporation (LMC) ADST II contract with STRICOM. The contract required LMC to support the development of the SEDRIS Data Model and API. SEDRIS as an emerging standard for database exchange in the Military community. This effort included the development of software to evaluate the SEDRIS data model, support in the development of the data model and the software API through participation in working groups and e-mail discussions. The effort began May 20, 1997 and completed March 1, 1999.

1.3 Experiment Overview

The focus of the work is the development of a Level 0 SEDRIS API for the LMIS database generation software (Training and Rehearsal GEneration Toolkit, TARGET). The TARGET product has been under continuous development for over ten years and currently supports a variety of simulation programs, including the USAF Interoperable Visuals/Sensors for Air Combat Command (IVACC) Program, the Special Operations Forces at Kirtland Air Force Base (KAFB), and the US Army Advanced Gunnery Training System (AGTS) Program. In addition TARGET is used to maintain and update Standard Interchange Format databases at the Simulator Database Facility (SDBF), also at KAFB.

The TARGET system is centered on the Common Geographic Database (CGDB), which contains a correlated and fused digital representation of terrain, culture, models, and textures. This data will be valuable to other programs when it can be provided via the SEDRIS mechanism.

1.4 Technical Overview

The technical effort was divided into four main sections: Planning and System Design, SEDRIS Read API and CGDB Read API Prototype Software Development, Test and Evaluation, and Documentation. The total effort has been divided into many phases. This report documents the effort for the second phase of the development effort.

The current phase focused on the maturation of the SEDRIS Data Model and API, the development of the TARGET Read API for terrain and culture, and the interchange of data with other SEDRIS associates.

2. Applicable Documents

2.1 Government

-ADST II Work Statement for TARGET/SEDRIS API, May 1, 1997, AMSTI-97-WO39

2.2 Non-Government

-ADST II Program Directive "TARGET/SEDRIS D.O.0043", May 29, 1997, ADST II-PD-97-028, and amendments 1 (22DEC97) through 7 (30SEP98)

-ADST II Technical and Management Workplan for TARGET/SEDRIS API, April 10, 1998, ADST-II-CDRL-SEDRIS-9700277 Rev. C

-ADST II Software Design Description for TARGET/SEDRIS API, March 1, 1999, ADST-II-CDRL-SEDRIS-9700530

-ADST II Validation Methods Document for TARGET/SEDRIS API, March 1, 1999, ADST-II-CDRL-SEDRIS-9700531

-ADST II SEDRIS Mapping Document for TARGET/SEDRIS API, December 31, 1998, ADST-II-CDRL-SEDRIS-970528

3. System Description

3.1 System Configuration

The software developed for this D.O. was a result of writing new software that interfaced with the existing TARGET input/output software routines. For a further discussion of the description of the software development see the Software Design Description document.

3.2 Internal Research and Development

Concurrent with the development of this software, other software was developed with Lockheed Martin internal funds. These software packages include support for blended terrain import/export and moving model support in the TARGET/SEDRIS software, and software to support validation on OpenGL platforms. These software tools are not included in the delivered set of software for this D.O., since they relate to offline processing vice SEDRIS export or import. It is through a combined effort of support by Lockheed Martin and STRICOM that the SEDRIS data model and tools are prepared for public release.

4. Observations and Lessons Learned

4.1 Project Scheduling

Project scheduling was a challenge. The schedule was frequently impacted by the software dependencies on vendor APIs and the government's core software. Schedules were sometimes difficult to maintain as multiple SEDRIS contractors developed software congruently.

4.2 Data Complexity

The SEDRIS Data model is evolving into one of the most complex data representation models of synthetic environments ever conceived. This is by design. It is intended to capture all of the current data producer's data with as little loss as possible while being transportable between different database consumers. The complexity and flexibility of the data model has made the task of translating SEDRIS data objects into TARGET a challenging task. As the SEDRIS data model continues to evolve, the conversion software may require additional pattern recognition to translate data into TARGET.

4.3 Consumption Issues

Lockheed Martin Information Systems(LMIS) has been an important SEDRIS data consumer. LMIS has consumed data from Evans and Sutherland, Lockheed Martin Tactical Defense Systems, LMIS S1000, and LMIS TARGET data. As one of the first consumers, LMIS has raised many questions and supported SEDRIS development in identifying business rules and other consumer needs. Now that more SEDRIS consumers exist, others are raising the same issues that LMIS had. To be successful, SEDRIS must acknowledge the benefit of value-added data to the consumer.

One of the primary issues in consuming SEDRIS data is the size of the data set within a single transmittal. Although in-memory processing can sometimes mitigate this problem by allowing modification of the transmittal file, there are subsequent issues in resolving data relationships. STF files restrict the consumer's control and the consumer is dependent on how efficiently the producer has stored the data in SEDRIS. Processing time can be significant, if a producer or consumer is processing a transmittal that contains a large database. It is in the interest of consumers for SEDRIS to support a means of dividing large data sets across multiple transmittals.

5. Performance Evaluation

5.1 Technical Performance

All of the technical milestones were met. This includes software that interchanges cultural features and texture data between the SEDRIS Data model and TARGET. Support was provided in the development of the SEDRIS Data Model. The required interchanges were successfully completed. The Validation Methods document provides specific technical results.

The primary output of the project during this phase has been the development of the TARGET/SEDRIS software. During this phase the software has matured from only supporting the interchange of localized three dimensional features (models) to the support of imagery, surface features (terrain and culture), and colors (OTW and sensor).

A major portion of this D.O. was to support the maturation of the SEDRIS Data Model and API. This was accomplished through the submission of multiple changes to the data model (including a complete rewrite of the SEDRIS texture data representation), identification of business rules, and participation in SEDRIS workshops, SEDRIS Associates Meetings and support for various public demonstrations (SIW, ITEC, I/ITSEC).

As the SEDRIS data model has changed, the mapping of data between SEDRIS and TARGET has also changed. This new mapping is reflected in the SEDRIS Mapping Document.

Previous to a SEDRIS format being identified for interchange experiments between different operating systems, at the end of 1997 the TARGET libraries were ported to the Silicon Graphics Workstation. This SGI platform was used by many SEDRIS data producers, and in-memory processing could have only been completed with SGI-compatible libraries. While this work was completed, additional work will need to be done in follow-on efforts to maintain this port (but is not needed with the identification of a SEDRIS transmittal format).

After the InTeriM file format (ITM – Data Model 1.06a) and SEDRIS Transmittal Format (STF – Data Model 1.33 and higher) were introduced in late 1998, LMIS participated by providing a 1 degree by 1 degree geodetic database (Salisbury Plain/Sussex) for others to consume, regardless of development platform. These ITM and STF transmittals included terrain, culture, 3D models, images, colors, and lights.

Over the life of this D.O., several large changes to the data model have resulted in an impact to the software development. These changes were planned but the impact to code development was significant and greater than expected. This was in some part due to the LMIS SEDRIS team maintenance and testing against various data producers' data, to ensure a continued ability to consume LMIS S1000, LMIS TARGET, E&S EaSIEST, and LMTDS DBGS data, and to produce TARGET transmittals for in-memory, ITM, and STF processing.

5.2 Financial Performance

The overall cost performance period followed closely to plan after some initial underruns the first six months due to delay in startup activities. The initial period of nine months was extended, with additional funding, to cover a total period of twenty one months. As a result, the funding level was increased from $231K to $421K. The most recent actuals, for the end of January 1999 were on plan at $408K. The estimated actuals for the final month are expected to be on plan.

6. Conclusion

With the recent public release of the SEDRIS core software many data producers, consumers, and database programs are evaluating SEDRIS as a method for data exchange, and in some cases as a replacement for SIF/SIF++. The work done at Lockheed Martin has contributed to the development of this new standard and will help to bring this new standard to acceptance.

Lockheed Martin has played an important role in SEDRIS. LMIS has authored the image portion of the data model, developed new software techniques incorporated into SEDRIS, participated in daily e-mail discussions and attended SEDRIS Associates Meetings. LMIS has been successful in consuming multiple producers' data in various formats. LMIS demonstrated interoperability by consuming Evans and Sutherland CCTT data and subsequently flying the data on one of LMIS's real-time simulation systems.

LMIS has raised several issues in the aspect of consuming large transmittals (in-memory or STF). SEDRIS must in the future recognize the system constraints that consumers may have, and identify a means to divide large transmittals into smaller extraction pieces. The challenge will be to maintain data consistency between these transmittal pieces. While these elements of SEDRIS must continue to mature, the degree of interchange that LMIS has been able to achieve with SEDRIS has been excellent. LMIS views SEDRIS as a foundation for managing interoperablility across the many subsystems in an LMIS training system. LMIS is committed to continued participation in the SEDRIS community to advance the standard and apply it for the benefit of operational programs. It is by this continued association that both SEDRIS and Lockheed Martin can grow in the simulation community.

7. Points of Contact

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